CHAPTER

2

INTRODUCTION TO SURVEYING

Definition of Surveying, Aims and applications, Fundamental principles of surveying, Classification of surveying, Plans and maps, Scales, Units of measurement.

2.1 DEFINITIONS :

(1) Surveying :

(GTU June 2009, Janu. 2011)

Surveying is the art and science of determining the relative positions of various points or stations on the surface of the earth by measuring the horizontal and vertical distances, angles and taking the details of these points and by preparing a map or plan to any suitable scale. Thus, in surveying, the measurements are taken in the horizontal and vertical planes.

(2) Levelling :

Levelling is a branch of surveying which deals with the measurements of relative heights of different points on or below the surface of the earth. Thus, in levelling, the measurements (elevations) are taken in the vertical plane.

The knowledge of surveying is very useful in many phases of engineering. Surveying, although simple in concept, requires great skill and practice for doing the work accurately and economically. It requires basic knowledge of mathematics, physics, astronomy etc.

2.2 AIMS OF SURVEYING :

(GTU June 2009, Winter 2013)

The object of surveying is to prepare a map or plan to show the relative positions of the objects on the surface of the earth. The map or plan is drawn to some suitable scale. It shows boundaries of districts, states and countries too. It also includes details of different engineering features such as buildings, roads, railways, dams, canals etc.

2.3 APPLICATIONS OF SURVEYING : (GTU June 2009, Winter 2013)

Surveying may be used for the following purposes :

(1) To prepare a topographical map which shows hills, valleys, rivers, forests, villages, towns etc.

(2) To prepare a cadastral map which shows the boundaries of fields, plots, houses and other properties.

(3) To prepare an engineering map which shows the positions of engineering works such as buildings, roads, railways, dams, canals, etc.

(4) To prepare a contour map to know the topography of the area to find out the best possible site for roads, railways, bridges, reservoirs, canals, etc.

(5) Surveying is also used to prepare military map, geological map, archaeological map etc.

(6) For setting out of works and transferring details from the map on the ground.

2.4 PRIMARY DIVISIONS OF SURVEYING : (GTU June 2009, Janu. 2011)

We know that the shape of the earth is spheroidal. Thus, the surface is obviously curved. Surveying is primarily divided into two types considering the curvature of the earth's surface.

(1) Plane surveying

(2) Geodetic surveying

(1) Plane Surveying :

The plane surveying is that type of surveying in which earth surface is considered as a plane and the curvature of the earth is ignored. In such surveying a line joining any two stations is considered to be straight. The triangle formed by any three points is considered as a plane triangle and the angles of the triangles are considered as plane angles.

Plane surveying is carried out for a small area of less than 250 km^2. It is carried out by local or state agencies like the R & B department, Irrigation department, Railway department, etc.

(2) Geodetic Surveying : (GTU, Summer 204)

The geodetic surveying is that type of survey in which the curvature of the earth is taken into account. It generally extends over large areas. The line joining any two stations is considered as a curved line. The triangle formed by any three points is considered as spherical and the angles of the triangles are considered to be spherical angles. (Fig. 2.1). Geodetic surveying is conducted by the Survey of India Department and is carried out for a large area exceeding 250 km^2.

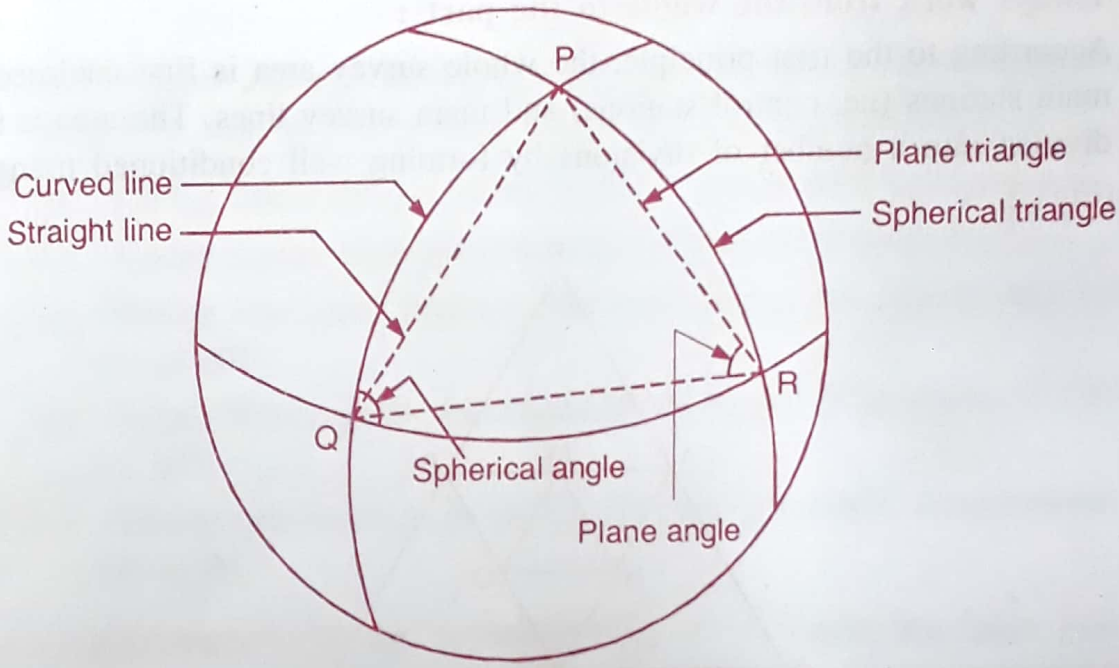

Fig. 2.1 Geodetic surveying

Plane surveying v/s Geodetic surveying : (GTU, Sept.2009, Dec. 2010, Winter 2014, Summer 2015)

No.	Plane Surveying	Geodetic surveying
(1)	The earth surface is considered as a plane surface	The earth surface is considered as a curved surface.
(2)	The curvature of the earth is ignored	The curvature of the earth is taken into account.
(3)	Line joining any two stations is considered to be straight	The line joining any two stations is considered as a curved line.
(4)	The triangle formed by any three points is considered as a plane.	The triangle formed by any three points is considered as spherical.
(5)	The angles of the triangles are considered as plane angles.	The angles of the triangles are considered to be spherical angles.
(6)	Carried out for a small area < 250 km^2.	Carried out for a large area > 250 km^2.

2.5 FUNDAMENTAL PRINCIPLES OF SURVEYING :

(GTU Dec. 2008, Janu. 2011, June 2011, Dec. 2011, Sum.2013, Winter 2013, Summer 2015)

Two basic principles of surveying are :

(1) Always work from the whole to the part, and

(2) To locate a new station by at least two measurements (linear or angular) from fixed reference points.

(1) Always work from the whole to the part :

According to the first principle, the whole survey area is first enclosed by main stations (i.e. control stations) and main survey lines. The area is then divided into a number of divisions by forming well conditioned triangles. (Fig. 2.2).

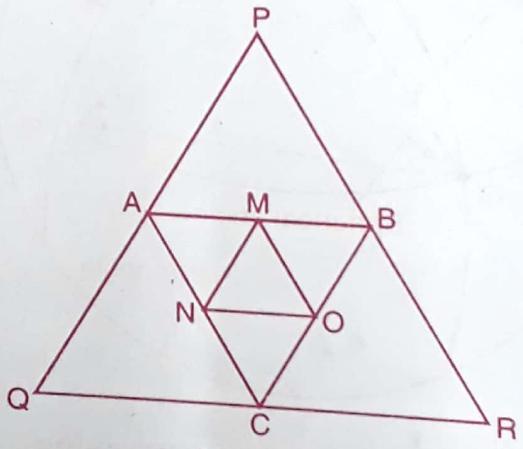

Fig. 2.2

The main survey lines are measured very accurately with precise survey instruments. Then the remaining sides of the triangle are measured. The purpose of this method of working is to control accumulation of errors. During measurement, if there is any error, then it will not affect the whole work. But if the reverse process is followed then the minor error in measurement will be magnified.

(2) To locate a new station by at least two measurements (linear or angular) from fixed reference points :

(GTU, April 2010)

According to the second principle the points or stations are located by linear or angular measurement or by both in surveying. If two control points are established first, then a new station can be located by two linear or two angular measurements or by one linear and one angular measurement. Let A and B are control points. A new point C can be established. Following are the methods of locating point C from such reference points A and B. (Fig. 2.3).

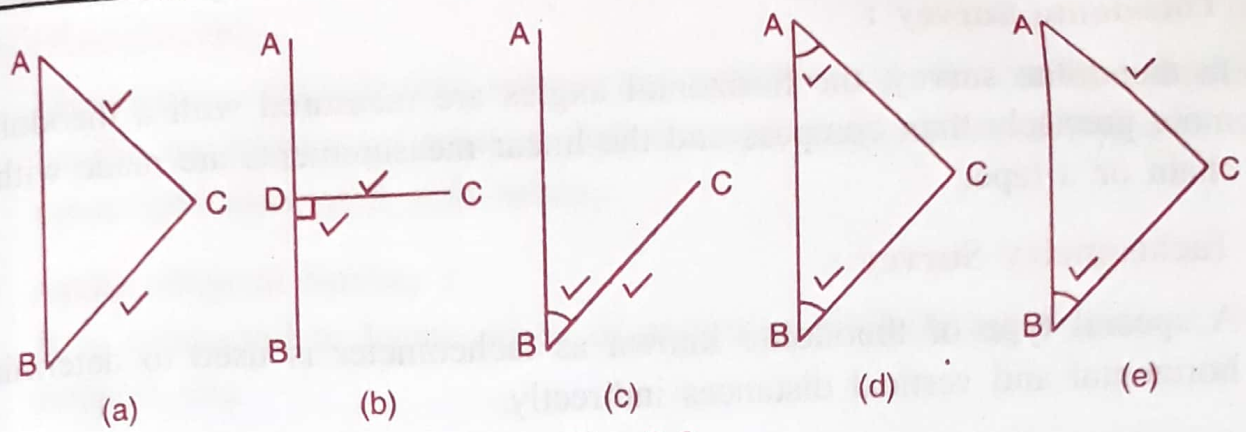

Fig. 2.3

The distance AB can be measured accurately and the relative positions of the points can be then plotted on the sheet to some scale.

(a) Taking linear measurements from A and B for C.

(b) Taking linear measurement of perpendicular from D to C.

(c) Taking one linear measurement from B and one angular measurement as $\angle$ ABC.

(d) Taking two angular measurements at A and B as angles $\angle$ CAB and $\angle$ ABC.

(e) Taking one angle at B as $\angle$ ABC and one linear measurement from A as AC.

2.6 CLASSIFICATION OF SURVEYING : (GTU Dec. 2010, June 2012)

Surveys can be classified into various categories depending on the purposes, instruments and methods used and the nature of the field.

2.6.1 Classification based on Instruments :

(a) Chain Survey :

This is the simplest type of surveying in which only linear measurements are made with a chain or a tape. Angular measurements are not taken.

(b) Compass Survey :

In compass survey, the angles are measured with the help of a magnetic compass.

(c) Chain and Compass Survey :

In this survey linear measurements are made with a chain or a tape and angular measurements with a compass.

(d) Plane Table Survey :

It is a graphical method of surveying in which field works and plotting both are done simultaneously.

(e) Theodolite Survey :

In theodolite survey, the horizontal angles are measured with a theodolite more precisely than compass and the linear measurements are made with a chain or a tape.

(f) Tacheometry Survey :

A special type of theodolite known as tacheometer is used to determine horizontal and vertical distances indirectly.

(g) Levelling Survey :

This type of survey is used to determine the vertical distances (elevations) and relative heights of points with the help of an instrument known as level.

(h) Photogrammetric Survey :

Photogrammetry is the science of taking measurements with the help of photographs taken by aerial camera from the air craft.

(i) EDM Survey :

In this type of survey, all measurements (lengths, angles, co–ordinates) are made with the help of EDM instrument (i.e. total station).

2.6.2 Classification based on Methods :

(a) Triangulation :

Triangulation is a basic method of surveying. When the area to be surveyed is large, triangulation is adopted. The entire area is divided into a network of triangles.

(b) Traversing :

A traverse is a circuit of survey lines. It may be open or closed. When the linear measurements are done with a chain and a tape and the directions or horizontal angles are measured with a compass or a theodolite respectively, the survey is called traversing.

2.6.3 Classification based on Purposes :

(a) Geological Survey :

In this both surface and subsurface surveying are conducted to locate different minerals and rocks. In addition, geological features of the terrain such as folds and faults are located.

(b) Mine Survey :

Mine surveys include both surface and underground surveys. It is conducted for the exploration of mineral deposits and to guide tunnelling and other operations associated with mining.

(c) Archaeological Survey :

It is conducted to locate relics of antiquity, civilization, kingdoms, forts, temples, etc.

(d) Military Survey :

It has a very important and critical application in the military. Aerial surveys are conducted for this purpose. It is conducted to locate strategic positions for the purpose of army operations.

2.6.4 Classification based on Nature of Field :

(a) Land Survey :

Land survey is done on land to prepare plans and maps of a given area. Topographical, city and cadastral surveys are some of the examples of land surveying.

(b) Hydrographic Survey :

This survey is conducted on or near the body of water such as lake, river, coastal area. This survey consists of locating shore lines of water bodies.

(c) Astronomic Survey :

The surveys are conducted for the determination of latitudes, longitudes, azimuths, local time, etc. for various places on the earth by observing heavenly bodies (The sun or stars).

(d) Aerial Survey :

An aerial survey is conducted from aircraft. Aerial cameras take photographs of the surface of the earth in overlapping strips of land. This is also known as photographic survey.

2.7 PLANS AND MAPS : (GTU, Summer 2014, Summer 2015)

One of the basic objectives of surveying is to prepare plans and maps.

(1) Plan :

A plan is the graphical representation, to some scale, of the features on, near or below the surface of the earth as projected on a horizontal plane. The horizontal plane is represented by the plane of the drawing sheet on which

the plan is drawn to some scale. However, the surface of the earth is curved, it cannot be truely represented on a plan without distortion. In plane surveying, the areas involved are small, the earth's surface may be considered as plane and hence plan is constructed by orthographic projections. A plan is drawn on a relatively large scale.

(2) Map :

If the scale of the graphical projection on a horizontal plane is small, the plan is called a map. Thus graphical representation is called a plan if the scale is large while it is called a map if the scale is small.

On a plan, generally, only horizontal distances and directions or angles are shown. On a topographic map, however the vertical distances (elevations) are also represented by contour lines.

(3) Scale :

It is the basic requirement for the preparation of plans or maps. Scale is used to represent large distance on paper. The ratio by which the actual length of the object is reduced or increased in the drawing is known as the **'scale'**. For an example, if 1 cm on a map represents a distance of 10 metres on the ground, the scale of the map is said to be 1 cm = 10 m.

(4) Representative Fraction (RF) :

The ratio of the distance on the drawing to the corresponding actual length of the object on the ground is known as the representative fraction. i.e.

$$RF = \frac{\text{distance of object on drawing}}{\text{corresponding actual distance of object on ground}}$$

(Both distances in same units, i.e. in cm.)

For example,

if a scale is

(i) 1 cm = 10 m.

$$R.F. = \frac{1}{10 \times 100} = \frac{1}{1000} \text{ or } 1:1000.$$

(ii) 1 cm = 100 m.

$$R.F. = \frac{1}{100 \times 100} = \frac{1}{10000} \text{ or } 1:10000$$

(iii) 1 cm = 1 km.

$$R.F. = \frac{1}{1 \times 1000 \times 100} = \frac{1}{100000} \text{ or } 1:100000$$

EXAMPLE-2.1 : A 10 km long road is indicated in a map by a length of 10 cm straight line. Calculate the scale and R.F. of a map.

SOLUTION :

10 cm on drawing sheet = 10 km. on ground

$\therefore$ 1 cm = 1 km. (scale of a map)

1 cm = 1 km

$$\therefore \quad \text{R.F.} = \frac{1}{1 \times 1000 \times 100} = \frac{1}{100000}$$

or R.F. 1:100000 **(Ans.)**

EXAMPLE-2.2 : An area of 49 cm^2 of a map represents an area of 2401 km^2. Find scale and R.F. of a map.

SOLUTION :

49 cm^2 represents 2401 km^2

$\therefore$ 1 cm^2 represents $\frac{2401}{49}$ = 49 km^2

1 cm^2 represents 49 km^2

$\therefore$ 1 cm represents $\sqrt{49}$ = 7 km.

$\therefore$ 1 cm = 7 km. (scale of a map)

$$\text{R.F.} = \frac{1}{7 \times 1000 \times 100} = \frac{1}{700000}$$

or 1:700000 **(Ans.)**

EXAMPLE-2.3 : A plan represents an area of 72,000 m^2 and measures 4.00 cm × 5.00 cm. Find the scale of the map and R.F.

SOLUTION :

4.00 × 5.00 cm^2 represents 72,000 m^2

$\therefore$ 1 cm^2 represents $\frac{72{,}000}{4.00 \times 5.00}$ = 3600 m^2

or 1 cm = $\sqrt{3600}$

i.e. 1 cm = 60 m (scale of the map)

$$\text{R.F.} = \frac{1}{60 \times 100} = \frac{1}{6000}$$

or R.F. = 1:6000 **(Ans.)**

EXAMPLE-2.4 : A plan represents an area of 75000 m^2 and measures 3.00cm × 5.00cm. Find the scale of the map and R.F. **(GTU Dec. 2011)**

SOLUTION :

3.00 × 5.00 cm^2 represents 75,000 m^2

$\therefore$ 1 cm^2 represents $\frac{75{,}000}{3.00 \times 5.00} = 5{,}000\ m^2$

or 1 cm = $\sqrt{5{,}000}$

i.e. 1 cm = 70.71 m (scale of the map)

$$\text{R.F.} = \frac{1}{70.71 \times 100} = \frac{1}{7071}$$

or R.F. = 1:7071 **(Ans.)**

EXAMPLE-2.5 : A surveyor measured the distances between two points on the plan drawn to a scale of 1 cm = 40 m and the result was 567 m. Later, however, he discovered that he used a scale of 1 cm = 20 m. Find the true distance between the points.

SOLUTION :

$$\text{Correct length} = \frac{\text{R.F. of worng scale}}{\text{R.F. of correct scale}} \times \text{Measured Length}$$

$$\text{R.F. of wrong scale used} = \frac{1}{20 \times 100} = \frac{1}{2000}$$

$$\text{R.F. of correct scale} = \frac{1}{40 \times 100} = \frac{1}{4000}$$

Measured length = 567 m.

$$\therefore \text{Correct length} = \frac{(1/2000)}{(1/4000)} \times 567$$

$$= 1134 \text{ m. } \textbf{(Ans.)}$$

Graphical Representation of Scale :

Another way to mention the scale on maps is by graphical representation. This is shown in Fig. 2.4.

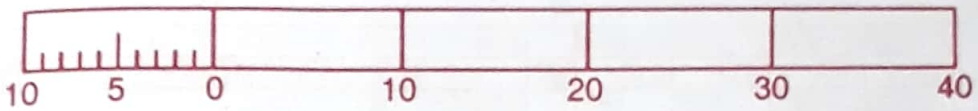

Fig. 2.4 Graphical representation of scale (1 cm = 5 m or R.F. = 1 : 500)

Graphical representation of scale on maps has the advantage that if the paper shrinks, the scale will also shrink accordingly and the distance representation will not be disturbed.

2.8 SCALES :

(1) Plain scale, (2) Diagonal scale, (3) Chord scale, (4) Vernier scale etc.

2.8.1 Plain Scale :

(GTU March 2009, Dec. 2010)

The plain scale is the most commonly used in maps. This scale is used to represent two successive units, such as units and tenths, metres, decimetres etc. The construction of a plain scale is illustrated in Example 2.5.

EXAMPLE 2.6 : Construct a plain scale of RF 1/500 to measure upto a metre and represent 37 m on the scale.

SOLUTION :

RF – 1/500 is the same as 1 cm = 5 m or 2 cm = 10 m. Take a line of length 12 cm and divide into six parts. Each part of length 2 cm represents 10 m. (Fig. 2.5). The part on the left extreme is divided into 10 equal parts and each division represences 1 m. The zero of the scale starts from the end of this part and the numbering at each part is marked as shown in the figure. To show or measure 37 m, we start from the 30 m mark and take seven division(fraction) towards the left from the zero. This gives 37 m as shown in Fig. 2.5.

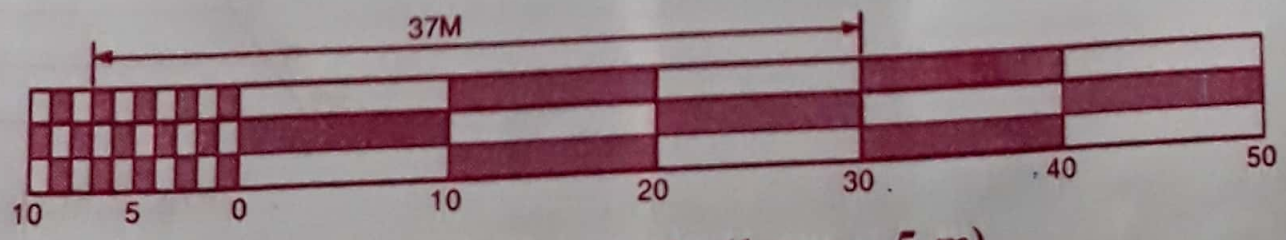

Fig. 2.5 Plain scale (1 cm = 5 m)

EXAMPLE 2.7 : Describe plane scale and draw a plane scale of 1 cm = 2m.

(GTU Dec. 2010)

SOLUTION : (Fig. 2.6)

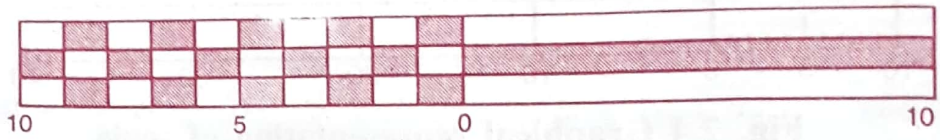

Fig. 2.6 Plain scale (1 cm = 2 m)

EXAMPLE 2.8 : Draw a plain scale of 1 cm = 2m and show on it 12 m.

(GTU June 2012)

SOLUTION : (Fig. 2.7)

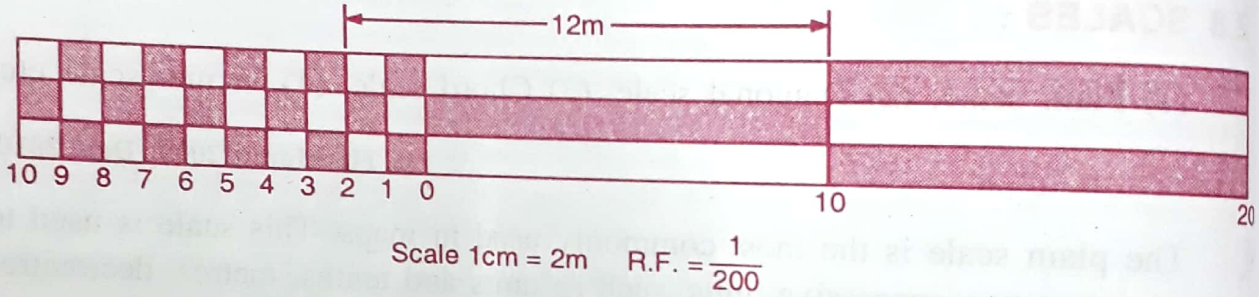

Fig. 2.7

2.8.2 Diagonal Scale :

(GTU March 2009)

Using a diagonal scale, one can measure three dimensions such as "units, tenths and hundredths", "metres, decimeters and centimeters", and so on. The diagonal scale is made on the principle of similar triangles as shown in Fig. 2.8(a).

A short length PQ can be divided into 10 parts as shown in Fig. 2.8(a). From similar triangles line 1–1 is equal to one-tenth of PQ line, 2–2 is two-tenth of PQ and so on. The construction of a diagonal scale is illustrated in Example 2.9.

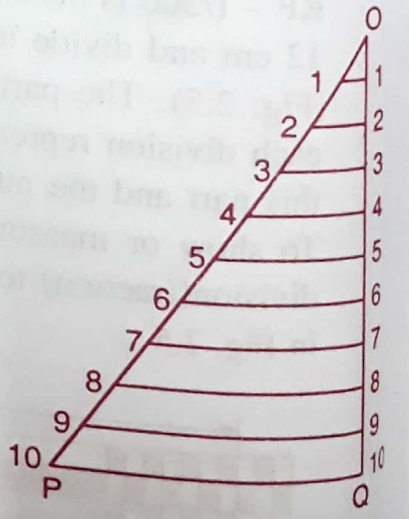

Fig. 2.8(a)

2.9 CHOICE OF SCALE OF A MAP :

Scale of a map is the ratio of the distance drawn on the map to the corresponding distance on the ground. As the areas involved are rather large, it is essential to select a suitable scale for representing the area on a map. Selection of the scale depends upon the purpose, size and the required precision of plotting. The following two general rules should be followed :

(i) Choose a scale large enough so that in plotting or in scaling distance from the finished map, it will not be necessary to read the scale closer than 0.25 mm.

(ii) Choose as small a scale as is consistent with a clear delineation of the smallest details to be plotted.

Scales are generally classified as large, medium and small as under :

Large scale : 1 cm = 10 m or less than 10 m.

Medium scale : 1 cm = 10 m to 100 m.

Small scale : 1 cm = 100 or more than 100 m.

Table 2.1 Common scales for plans and maps

Type of Map or Plan	Scale	R.F.
(1) Buildings Cadastral maps	1 cm = 10 m or less 1 cm = 10 m to 50 m.	1/1000 or less 1/1000 to 1/5000
(2) Town planning, reservoir planning etc.	1 cm = 50 m to 100 m	1/5000 to 1/10,000
(3) Route surveys	1 cm = 10 m to 60 m	1/1000 to 1/6000
(4) Longitudinal sections (a) Horizontal scale (b) Vertical scale	 1 cm = 10 m 1 cm = 1 m to 2 m	 1/1000 1/100 to 1/200
(5) Cross–section	1 cm = 1 m to 2 m	1/100 to 1/200
(6) Land surveys	1 cm = 5 m to 25 m	1/500 to 1/2500
(7) Topographical maps	1 cm = 2.5 km	1/250,000
(8) Geological maps	1 cm = 5 km to 160 km	1/5,00,000 to 1/160,00,000

For most of engineering projects, the scale varies from 1 cm = 2.5 m to 100 m. Small scale topographical maps are usually drawn to a scale 1 cm = 1 km. A scale of 1 cm = 5 m to 50 m is generally used for plans prepared for sub-divisions of land.

2.10 UNITS OF MEASUREMENT :

The system of units used in India in the recent years is M.K.S. and S.I. But all the records available in surveying done in the past are in F.P.S. units. Therefore, for an engineer it becomes necessary to know the conversion of units from one system to another, a few of which are listed below (Table 2.2) and many more can be computed.

Table 2.2

Length	Area
1 inch = 2.54 cm	1 are = 100 m^2
1 foot = 0.3048 m	100 are = 1 hectare
1 yard = 3 feet	1 hectare = 10,000 m^2
1 mile = 1.609 km	1 hectare = 2.471 acres
1 nauticalmile = 1.852 km	100 hectare = 1 km^2

✶ REMEMBER KEY POINTS ✶

1. Surveying is the art and science of determining the relative positions of various points or stations on the surface of the earth by measuring the horizontal and vertical distances, angles and taking the details of these points and by preparing a map or plan to any suitable scale.
2. In surveying the measurements are taken in the horizontal and vertical planes.
3. Levelling is a branch of surveying which deals with the measurement of relative heights of different points on or below the surface of the earth.
4. In leveling the measurements (elevations) are taken in the vertical plane.
5. The object of surveying is to prepare a map or plan to show the relative positions of the objects on the surface of the earth.
6. Primary divisions of surveying are :

   (i) Plane surveying (ii) Geodetic surveying
7. The plane surveying is that type of surveying in which earth surface is considered as a plane and the curvature of the earth is ignored. Plane surveying is carried out for a small area of less than 250 km^2.
8. The geodetic surveying is that type of surveying in which the curvature of the earth is taken into account. It generally extends over large areas.
9. **Fundamental principles of surveying are :**

   (i) Always work from the whole to the part and

(ii) To locate a new station by at least two measurements (linear or angular) from fixed reference points.

10. Classification of surveying :

(i) Classification based on instruments : Chain survey, compass survey, chain and compass survey, plane table survey, theodolite survey, tacheometry survey, levelling survey, photogrammetric survey and EDM survey.

(ii) Classification based on methods : Triangulation and Traversing.

(iii) Classification based on purposes : Geological survey, mine survey, archaeological survey and military survey.

(iv) Classification based on nature of field : Land survey, hydrographic survey, astronomic survey and aerial survey.

11. Plan : A plan is the graphical representation, to some scale, of the features on, near or below the surface of the earth as projected on a horizontal plane. A plan is drawn on a relatively large scale.

12. Map : If the scale of the graphical projection on a horizontal plane is small, the plan is called a map.

13. Scale : It is the basic requirement for the preparation of plans or maps. The ratio by which the actual length of the object is reduced or increased in the drawing is known as the scale.

14. R.F. : The ratio of the distance on the drawing to the corresponding actual length of the object on the ground is known as the representative fraction.

15. Types of scales :

(i) Plain scale (ii) Diagonal scale (iii) Chord scale (iv) Vernier scale

16. Plain scale : The plain scale is the most commonly used in maps. This scale is used to represent two successive units, such as units and tenths.

17. Diagonal scale : Using a diagonal scale, one can measure three dimensions such as 'units, tenths and hundredths'.

18. Chord scale : A scale of chords is used to measure or to set off angles. It is marked either on a rectangular protractor or on an ordinary box wooden scale.

19. Vernier scale : In 1631, Pierre Vernier invented a device for the purpose of measuring a fractional part of a graduated scale. It consists of two approximating scales, one of them is fixed and is called the primary scale, the other is movable and is called the vernier.

20. Selection of the scale depends upon the purpose, size and the required precision of plotting.

21. Scales are generally classified as large scale, medium scale and small scale.

✶ REVIEW QUESTIONS ✶

[1] G.T.U., Winter 2013

Q.2 (b) State and explain fundamental principles of survey. What are aims and applications of surveying? [P. 2.5, 2.2, 2.3] 07

[2] G.T.U., Summer 2014

Q.2 (a) (i) What is the difference between plan and map? [P. 2.8] 04

Q.4 (a) (ii) Explain geodetic surveying. [P. 2.4] 03

[3] G.T.U., Winter 2014

Q.2 (b) Differentiate between Plane surveying & Geodetic surveying. [P. 2.4] 04

[4] G.T.U., Summer 2015

Q.2 (a) Differentiate between Plane surveying and Geodetic Surveying. [P. 2.4] 03

(b) Explain fundamental principle of surveying in detail. [P. 2.5] 04

Q.3 (a) Differentiate between Plan and Map. [P. 2.8] 03

✶ EXERCISE ✶

1. Define : (a) Surveying (b) Levelling.
2. Differentiate between Surveying and Levelling.
3. What are the aims of surveying ?
4. Write applications of surveying.
5. Explain primary division of surveying.
6. Differentiate between plane surveying and geodetic surveying.
7. Explain the fundamental principles of surveying.
8. Discuss the classification of surveying based on :
   (a) Instruments used (b) Methods used
   (c) Purposes or objects (d) Nature of field
9. Define the following terms :
   (a) Map (b) Plan (c) Scale (d) R.F.
10. Differentiate between plan and map.
11. Explain the construction of the following scales.
    (a) Plain scale (b) Diagonal scale

✶ OBJECTIVE TYPE QUESTIONS ✶

1. In surveying, the measurements are taken in
   (a) Vertical plane (b) Inclined plane
   (c) Horizontal plane (d) Vertical and Horizontal plane
2. In leveling, the measurements are taken in
   (a) Horizontal plane (b) Vertical plane
   (c) Both the planes (d) Inclined plane
3. The object of surveying is to prepare a
   (a) Drawing (b) Cross-section
   (c) Sketch (d) Map
4. The method of plane surveying can be used when the extent of area is less than
   (a) 250 sq. km. (b) 500 sq. km.
   (c) 2500 sq. km. (d) 5000 sq. km.
5. The curvature of the earth is considered in
   (a) Plane surveying (b) Geodetic surveying
   (b) Hydrographic survey (d) Aerial survey
6. The main principle of surveying is to work from
   (a) Part to the whole (b) Whole to the part
   (c) Higher to lower level (d) Lower to higher level
7. Surveys which are carried out to depict mountains, valleys, rivers, forests and other details of a country are known as :
   (a) Cadastral surveys (b) Engineering surveys
   (c) Mine surveys (d) Topographical surveys
8. Plan is a graphical representation of the features on large scale as projected on :
   (a) Horizontal plane (b) Vertical plane
   (c) In any plane (d) None of the above
9. Which of the following scale is the smallest one ?
   (a) 1 cm = 5 m (b) R.F. = $\frac{1}{5000}$
   (c) 1:10,000 (d) 1 cm = 5 km
10. If a scale is 1 cm = 10 m, then R.F. is
    (a) $\frac{1}{10}$ (b) $\frac{1}{100}$ (c) $\frac{1}{1000}$ (d) $\frac{1}{10000}$
11. The plain scale is used to read
    (a) One unit (b) Two units
    (c) Three consecutive units (d) None of above
12. The diagonal scale is used to read
    (a) One unit (b) Two units
    (c) Three consecutive units (d) None of above

13. Scale of chords is used to measure
(a) Length (b) Angle (c) Area (d) Volume

14. Vernier scale is used to measure
(a) Fractional part of a plain scale
(b) Fractional part of a diagonal scale
(c) Fractional part of a graduated scale
(d) None of them

15. The scale should be large enough so that in plotting or in scaling distances from the map, it should not be necessary to read the scale closer than
(a) 0.50 mm (b) 0.25 mm
(c) 0.15 mm (d) 0.05 mm

16. Which of the following scale is the largest one? **[G.T.U., Winter 2013]**
(a) 1 cm = 50 m (b) 1:42000
(c) RF = 1/300000 (d) 1 cm = 50 km

17. Survey in which curvature of the earth surface is taken into account is **[G.T.U., Winter 2013]**
(a) Plane survey (b) Geological survey
(c) Geodetic survey (d) Hydrographic survey

18. Up to how much area the curvature of earth can be neglected? **[G.T.U., Winter 2014]**
(a) 100 km^2 (b) 150 km^2
(c) 250 km^2 (d) 300 km^2

19. If scale of a map is 1 cm = 50m, R.F. is **[G.T.U., Winter 2014]**
(a) 1/50 (b) 1/500
(c) 1/5000 (d) 1/50000

20. The object of surveying is to prepare a [G.T.U., Summer 2015]
(a) Drawing (b) Cross section
(b) Sketch (d) Map

21. The main principle of surveying is to work from. **[G.T.U., Summer 2015]**
(a) Part to the whole (b) Whole to the part
(c) Higher to lower level (d) Lower to higher level

22. Survey which carried out to represent mountains, valleys, rivers, forests and other details of a country are known as **[G.T.U., Summer 2015]**
(a) Cadastral surveys (b) Engineering surveys
(c) Mine surveys (d) Topographical surveys

Objective Answers

1. (c)	2. (b)	3. (d)	4. (a)	5. (b)	6. (b)	7. (d)	8. (a)
9. (d)	10. (c)	11. (b)	12. (c)	13. (b)	14. (c)	15. (b)	16. (a)
17. (c)	18. (c)	19. (c)	20. (d)	21. (b)	22. (d)		

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